STUDY OF GROWTH PARAMETERS IN HEALTHY CHILDREN 0-24 MONTHS IN AN URBAN SET UP.

Dissertation submitted to the

THE TAMILNADU Dr. M.G.R MEDICAL UNIVERSITY

in partial fulfilment for the award of degree of

M.D. BRANCH VII

PEDIATRIC MEDICINE

THE TAMILNADU DR. M.G.R. MEDICAL UNIVERSITY,

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The Institutional Review Board (Ethical Committee) of Institute of Child Health and Hospital for Children, Chennai was held on 19.12.2008 at 2.00 PM at the Deputy Superintendent's chamber.

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Title: "A study of growth parameters of Children 0-24 months of age attending OP at a Tertiary Care Centre".

The Institutional Review Board is satisfied with the proposal submitted by you. Hence the Board is pleased to approve the study. You are directed to modify the consent form sent along with the proposal.

Director and Superintendent

Director and Superintendent
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To
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CERTIFICATE

This is to certify that the dissertation titled **Study of growth parameters in healthy children 0- 24 months of age in an urban setup** is a original work done by Dr. P. Sathya in the Department of Pediatrics , Institute of Child Health and Hospital for Children, Egmore, Chennai -8 and has been done under our guidance and supervision during the period of her post graduate study for M.D (Branch VII) paediatrics.

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DECLARATION

I, **Dr. P. Sathya**, solemnly declare that the dissertation titled **"Study of growth parameters in healthy children 0- 24 months of age in an urban setup"** has been prepared by me.

This is submitted to the Tamilnadu Dr. M.G.R. Medical University, Chennai in partial fulfillment of the rules and regulations for the M.D. Degree Examination in Pediatrics.

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Date :

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CONTENTS

INTRODUCTION

Physical growth is, from conception to maturity, a complex process influenced by environmental, genetic, and nutritional factors. Normal growth is a strong indicator of nutritional sufficiency and overall health of an infant. Since infancy is a period of rapid growth, particularly early infancy, identifying growth failure is important and requires prompt medical attention.

The first 5 years of life are a period of extraordinary physical growth and increasing complexity of function. The child triples his or her birth weight within the first year and achieves two thirds of his or her brain size by age 2½–3 years. The child progresses from a totally dependent infant at birth to a mobile, verbal person who is able to express his or her needs and desires by age 2–3 years. It is critical for the clinician to identify disturbances in growth and development during these early years because there may be windows of time or sensitive periods when appropriate interventions may be instituted to effectively address growth and developmental issues.[1]

The assessment of growth is an important part of paediatrics and community child health. Poor growth is a common side-effect of many local and systemic conditions and its identification acts as a useful early warning of a possible problem. In addition, disorders directly affecting growth, for example, growth hormone deficiency can be diagnosed only through growth monitoring.

The process of growth assessment involves single or multiple measurements of height and/or weight, and sometimes more specialized measurements, plotted on suitable reference charts and interpreted appropriately. Careful attention needs to be given to the processes of measurement, recording and interpretation of results.

Eighty percent of the world's undernourished children live in 20 countries, with India being home to nearly 60 million children who are underweight.[30] The National Family Health Survey (NFHS) in India reported the prevalence of underweight among children younger than 3 years in 2005–2006 to be nearly 46%, a figure representing only a marginal decline from the rates recorded in 1992–1993 (51%) and 1998–1999 (47%).[2-5]

Although world children appear to follow a similar growth pattern, still there are variations due to ethnic, geographical and regional factors giving differences in the velocity of growth and adult stature. Hence every country has national growth standard [9]. Even among nations, there are small differences in height and weight (3% and 6% respectively) in different ethnic groups with similar socioeconomic status. In contrast, the varying socioeconomic status can have higher difference in height and weight (12% and 30%).therefore both genetic and ecologic background and their mutual interaction to be taken into consideration in construction of growth references[6].

Similarly Goldstein and Tanner [7, 8] had argued for local standards, which need to be updated from time to time to account for changing socioeconomic level .The use of western standards set an unattainable goal and over estimate of degree of under nutrition among children.

Our study is one such study to assess the growth pattern of babies 0-24 months and to compare with standard charts.

GROWTH

Growth and development begins at conception and end at maturity. They are the unique characteristics of children and any obstacle in this process at any age results in aberration of growth and/or development. Growth is defined as an increase in the size of an individual, due to increase in number and size of the cells, resulting in overall increase. This increase can be seen, appreciated and measured accurately [9]. Development, the individual level of functioning of a child is capable of as a result of maturation of the nervous system and psycho logic reactions.

Growth and development of a child is a continuous and orderly process.

The growth of a child always proceeds in a cephalocaudal direction. Head control is obtained first followed by neck then arms and legs. It is also disto proximal

Growth can be measured in terms of

1. Nutritional anthropometry

2. Assessment of tissue growth

3. Bone age

4. Dental age

5. Biochemical and histological means

Nutritional anthropometry includes measurement of weight, height, circumference of head, chest, abdomen and pelvis. There are also age independent parameters to measure growth like Quacstick, Quetlets index, Body mass index, mid arm to head circumference ratio etc.

Anthropometry is the measurement of physical dimensions of the human body at different ages. Anthropometric measurements are commonly used for assessing growth and nutritional status of children[10,11]

Growth monitoring is very important because growth is a fundamental characteristic of childhood. Despite being influenced by many factors, it remains remarkably predictable. Normal growth is an indicator of optimum health. Periodic assessment facilitates early detection of growth faltering which may be the first manifestation of a disease / infection.

Growth charts are the most important tool in monitoring growth of individual child. A standard chart contains Weight for age, Height for age, head circumference and mid arm circumference.

Weight reflects bone and muscle mass of child. Height/length reflects growth in stature .Head circumference is indicator of brain growth. Head circumference starts to increase from 20 weeks of intrauterine life to 20 months postnatal age. All these parameters of growth increase rapidly during early childhood. Faltering in growth of children in weight parameter is concentrated in

3-12 months, whereas faltering in height is seen in child more than 12 months. Hence growth monitoring is crucial during this vulnerable period of childhood.

Growth is influenced by various bio physiologic and psycho social factors. Aberrant growth may be the first sign of underlying illness [12]. There are several growth standards available to measure children.

Assessment of growth

Despite the facts that the National Centre for Health Statistics (NCHS) tables represent cross-sectional rather than longitudinal data and that children tend to grow in spurts, most children tend to track along a percentile, referred to as "following the curve." A normal exception commonly occurs during the first 2 yr of life. For full-term infants, size at birth reflects the influence of the uterine environment; however, size at age 2 yr correlates with mean parental height, reflecting the influence of genes. Between 6 and 18 mo of age, infants may shift percentiles upward or downward toward their genetic potential.

Growth parameters

Weight

Body weight is a reproducible growth parameter and **a** good index of acute and chronic nutritional status. An accurate age, sex and reference standard is necessary for evaluation. Weight can be measured using a beam scale or

Salter type scale with pans on which child is placed. For older children, the weight should be accurate nearest to 500 gm and for small children to 100 gm.

Weight is evaluated in three ways: weight for age, weight for height, and body mass index **(BMI).** Weight for age compares the individual to reference data for weight attained at any given age whereas weight for height looks at the appropriateness of the individual's weight compared to his or her own height.

Length

Measured with appropriate equipment and technique, length is a simple and reproducible growth parameter that provides, in conjunction with weight, significant information.

Measurement of length is frequently erroneous because of improper technique or equipment. The patient should be standing erect, without shoes, above the scale platform or on the floor. Shoulders should be straight, and the subject should look straight ahead. Children younger than 2 years of age should be measured recumbent on an infant meter. Measurements should be to the nearest 0.5 cm.

Head Circumference

Head circumference can be influenced by nutritional status until the age of 36 months, but deficiencies are manifest in weight and height before being seen in brain growth. Routine examination also screens for other possible influence on brain growth.

A flexible, narrow tape measure is placed firmly around the head above the supra orbital ridges and over the frontal bulge, where the circumference is the greatest. Measurements should be taken to the nearest 0.5 cm

Weight for Height

This ratio more accurately assesses body build and distinguishes Wasting (acute malnutrition) from stunting (chronic malnutrition).

Measurements that fall near the 50^{th} percentile indicate appropriate weight for height; the greater the deviation, the more over or undernourished Individual

Body Mass Index

Body mass index is determined by dividing the person's weight in kilograms by their height in meters square. The formula for BMI is:

$$BMI = \text{weight (kg)}/\text{height (meters)}^2$$

Growth Velocity

Growth velocity is a simple and reproducible measure that evaluates change in rate of growth over a specified time period. It is a more sensitive way of assessing growth failure or slowed growth and is particularly helpful in the early identification of children with under nutrition.

Mid arm circumference

It is usually measured in the left upper arm midpoint between the acromion and olecranon process. The measurement nearest to 0.1 cm to be taken.

OTHER INDICES OF GROWTH [12]

BODY PROPORTIONS:

Body proportions follow a predictable sequence of changes with development. The head and trunk are relatively large at birth, with progressive lengthening of the limbs throughout development, particularly during puberty. The lower body segment is defined as the length from the symphysis pubis to the floor, and the upper body segment is the height minus the lower body segment. The ratio of upper body segment divided by lower body segment (U/L ratio) equals approximately 1.7 at birth, 1.3 at 3 yr of age, and 1.0 after 7 yr of age. Higher U/L ratios are characteristic of short-limb dwarfism or bone disorders, such as rickets.

SKELETAL MATURATION:

Bone age correlates well with stage of pubertal development and can be helpful in predicting adult height in early- or late-maturing adolescents. Skeletal maturation is linked more closely to sexual maturity rating than to chronological age. It is more rapid and less variable in girls than in boys.

DENTAL DEVELOPMENT:

Dental development includes mineralization, eruption, and exfoliation. Delayed eruption is usually considered when there are no teeth by approximately 13 month of age (mean + 3 standard deviations). Nutritional and metabolic disturbances, prolonged illness, and certain medications (tetracycline)

commonly result in discoloration or malformations of the dental enamel. A discrete line of pitting on the enamel suggests a time-limited insult

First year:

AGE 0–2 MONTHS

In this period, the infant experiences tremendous growth A newborn's weight may decrease 10% below birth weight in the 1st wk. Infants regain or exceed birth weight by 2 wk of age and should grow approximately at 30 g (1 oz)/day during the 1st mo . This is the period of the fastest postnatal growth.

AGE 2–6 MONTHS

Between 3 and 4 mo of age, the rate of growth slows to approximately 20 g/day. By 4 month, birth weight is doubled

AGE 6–12 MONTHS

Growth slows more. By the 1st birthday, birth weight has tripled, length has increased by 50%, and head circumference has increased by 10 cm

Table:- 1 Growth requirements

AGE	APPROXIMATE DAILY WEIGHT GAIN (g)	GROWTH IN LENGTH (cm/mo)	GROWTH IN HEAD CIRCUMFERENCE (cm/mo)
0–3 mo	30	3.5	2.00
3–6 mo	20	2.0	1.00
6–9 mo	15	1.5	0.50
9–12 mo	12	1.2	0.50

REVIEW OF LITERATURE

The study of human growth had been a matter of absorbing interest for many workers in developing as well as developed countries. These studies are important as they reflect the Nation's health status.

An important centre for growth study was the University of Iowa, for more than half a century. Dr. B. T. Baldwin published his monograph on physical growth of children in 1921.

Among the early studies on growth at University of London Institute of Child Health and Education organised a multi disciplinary study from birth to five years in a group of London children between 1951 and 1954.

The Harvard study results were later published and the weight and height of children studied were included in the various percentile values at different ages.

Tanner and white house [13] conducted extensive studies on growth parameters. They have set up mean values for height and weight for various age groups. Goldstein and Tanner, have argued for local standards; which need to be updated from time to time to account for changing socioeconomic level.

In a study conducted by Gopalan, et al in 1967 [14],the growth pattern of low socioeconomic group children from 1 month to 6 years of age, he found that

the actual weight of infants in the first 6 months were lower than those of normal infants elsewhere. Both height and weight were below 10th centile of American standard.

Studies on the velocities of physical growth in the first 5 years were done by Kurar Aganmal and Strivatsava from New Delhi in 1971[15].This demonstrated that gain in weight was similar to British children only upto 6 months of life as compared to American standard.

In 1973 Data Banick [16] in another study on the epidemiological basis of malnutrition in preschool children reported that the 50th percentile of height and weight of these children in slum areas were far below the 10th percentile of American standard. Also there was skeletal growth retardation.

In 1978 the health and nutritional status of preschool children in rural Tamil Nadu was studied by Dr. Chandra & Vertasarey[17], the mean height and weight were far below the Indian Standard.

Vimlesh et al [18] in 1979 in an article named growth reference standard in developing countries say that the definition of optimum growth in children in developing countries is still the most debated problem due to its complicity and diverse characteristics of the population with regard to religion, region, socioeconomic status and heredity. As he has rightly put the above cited

reference and studies show that the growth parameter for different age group have shown wide variation in different parts of the country in different sites.

Khan A.Z; Singh Hasan SB et al from Aligarh UP India have shown that in the developing countries the growing children by and large are deprived of good nutrition on account of their poor socioeconomic status, ignorance and lack of health promotional facilities. This nutrition deprivation results in relative stunting of growth.

Growth charts

There are many types of growth charts in common use in different countries.

1. Harvard standard charts (1929-39)

2. NCHS 1963-1974.CDC growth charts

3. British children-Tanner et al 1966

4. European Growth standards - Czechoslovakia; Denmark; Hungary; Norway and Sweden.

5. Asian- China, Japan, HongKong, Thailand, Taiwan and India

Dr. Agarwal DK, Agarwal KN, Physical growth in Indian affluent children (birth to 6 years) [19] has measured growth characteristics, viz, height, weight, circumference of head, chest and mid arm in urban affluent children from seven centres (Bangalore , Calcutta , Delhi , Kota, Ludhiana and Varanasi – Nutrition

Foundation of India study).They observed values lower than European and NCHS standards and they concluded that the differences in growth seem to be possibly due to lower velocity in Indian children in the first 18 months as compared to the American children.

Official 2000 Centres for Disease control (CDC) growth charts and percentile charts by NCHS [20]

1. It was constructed from data accumulated from USA. It does not represent children from developing countries.

2. There is no certainty that the growth parameters of NCHS database is optimal- They may be too fat, and bigger is not necessarily better

3. In most of the developing countries, growth failure in children is widespread and severe .Estimates of malnutrition on the basis of NCHS reference would, therefore, overestimate the true extent of the problem.

4. Health planners may find targets based on NCHS standards unattainable.

World Health Organisation, a growth chart for international use in maternal and child health care. Geneva, 1978 [21]

1. WHO growth chart for international use was developed by reviewing the charts from various regions from both developed and developing countries.

2. The interpretation of weight curve on service chart must be made in relation to five reference lines in the weight grid. The channels formed by those lines were labelled with the letters A, B, C, D, E, F for the purpose of identification of nutritional status of the children. It proposes that each country should decide from existing local data, which of these channels best represents the current status of most of the population.

3. In this report, WHO opines that countries or region might eventually develop local reference standards in the interim, these reference lines should provide a substitute.

WHO Multi-centre Growth Reference Study

The WHO conducted a multi-centre study and collected growth data and related information on about 8500 children from diverse ethnic backgrounds and cultural settings [22, 23] .The study was designed to combine a longitudinal follow up of children from birth to 24 months and across sectional study of children aged 18 to 71 months.

1. Children were selected from communities where there were no environmental constraints to growth. They were healthy term infants who had no known illness or conditions that might affect their growth, and were breast fed as per the international feeding guidelines.

2. The new growth reference is based on breastfeeding as biological norm. The data showed great similarities in growth across all study centres [23, 24]

3. The new standards demonstrate that child populations in different regions of the world have the same growth potential. They can attain same heights and weights when their health care needs are met.
4. Genetic influence on the ultimate height in adulthood cannot be ruled out

In a study conducted by Shankar Prinja, Jarnail Singh Thakur & Satpal Singh Bhatia (2008)[25] . Pilot testing of WHO Child Growth Standards in Chandigarh: implications for India's child health programmes to compare the prevalence of underweight as calculated using IAP standards with the WHO Child Growth Standards and discuss the implications for child health programmes in India. They found that according to the IAP classification, around half the children (50.2%) under 5 years were underweight. When the WHO Child Growth Standards were applied, the prevalence of underweight was seen to rise from birth up to age 36 months and to decline thereafter before rising again from 48–60 months.

A study by Ramachandran P (2006) [26],has shown the IAP normal (≥ 80% of the Harvard median) is well below the median by the new WHO standards in the first 6 months of life, but it is above the median by such standards by 12 months of age and remains higher thereafter.[26]

Another study comparing NCHS and WHO growth standards reported that healthy breastfed infants followed the WHO standards' weight-for-age mean *Z*-score, while appearing to falter on the NCHS standards from age 2 months onwards.[27]

STUDY JUSTIFICATION

The growth charts offer a simple and inexpensive means of monitoring child health and nutritional status in local health services. It can be utilized with minimal instructions and supervision.

The charts represent a convenient means of organising and presenting data and permits the assessment of current status as well as observation of trends in growth performance. It facilitates the classification of nutritional status and thus provides an objective basis for decision making in relation to care.

The precise criteria that are used to interpret growth chart data and to define the levels of care required must however be determined on the basis of local needs, resources available and service pattern.

Because of its essentially visual character, the chart provides the health worker with a useful instrument for educating mother and family. It promotes a clearer understanding of the nature of growth and portrays clearly the consequences of an inadequate diet and infectious disease. In this way, it contributes to greater acceptance of responsibility for child care by the mother and to the concept of family self reliance in health matters.

It is clear that local reference standards should be used for comparison as

1. Use of local standards will provide a picture of the average in a country in order to identify groups or individuals who are above or below average.

2. It was felt that the selection of malnourished children by anthropometric variables could only be done successfully by local reference which represents " acceptable growth in a given environment"

3. WHO growth charts represent growth of child in an ideal environment and is based on breastfeeding as biological norm, this may not be the situation in many developing countries where cultural and feeding practices vary widely.

Many developing countries are experiencing secular trends of increasing weight and height, making it necessary to update local population- average reference after several years.

This study was planned with the aim of constructing a reference standard and to compare with recent WHO growth charts.

AIM OF THE STUDY

1. To establish standards for height, weight, head circumference and mid arm circumference of children between 0-24 months in urban set up.
2. To compare the growth curves obtained with the standard- WHO Charts.

METHODOLOGY

Design: Cross sectional survey

Settings:

1. Well baby clinics and immunization clinics at Institute of Obstetrics and Gynaecology and Kasthuri bai Gandhi Hospital and institute of child health and hospital for children.

2. Babies attending cretches.

Duration of study: October 2008 to August 2010**.**

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Study population:

Healthy babies aged between 0 months to 24 months of both sex

Inclusion criteria:

1. Term baby
2. Babies with birth weight more than 2500 gm
3. Those babies with valid birth data**.**

Exclusion criteria:

Babies with any chronic illness and those with major congenital anomalies

Sampling technique: Stratified random sampling

Sample size:

After analyzing previous studies and consulting with statistician the sample size for study was detected to be 896.

SAMPLING PROCEDURE:

Sampling frame consisted of babies from 0-2 yrs (0-24 months).

50% of the sample was male and 50% was female

For each group – 128 children

64 male and 64 female children.

There were seven groups (128 * 7)

TOTAL = 896 children.

Manoeuvre:

All babies satisfying the study criteria of both sexes were recruited in the study. The age and birth weight of the babies were checked by verifying the birth records.

Data collection:

After getting informed consent, a pre-designed questionnaire, containing details of breast feeding and feeding patterns in children, socio-economic status and anthropometric measurements were recorded.

Standard operating procedures for anthropometric measurement

After getting the informed consent, these babies were subjected to the following anthropometric measurements.

Weight

The baby was made to lie or sit in the centre of balance scale platform. Minimal clothing and no shoes were worn. It was measured with a standard electronic weighing machines with accuracy of 50 gm. Before recording weight of each child, it was checked whether the display showed zero.

Length

Length was recorded for babies under 2 yrs. Baby placed supine on an infant meter. Shoes were removed. The head was held firmly in position against a fixed upright head board. The legs were straightened, keeping feet at right angles to leg with toes pointing upwards. A free foot board was brought into firm contact with child heels. Length measured from scale to the nearest 0.5 cm.

Head circumference

A flexible, narrow inch tape measure placed firmly around head, above the supra orbital ridges and over the frontal bulge, leaving out the pinna of ear, where the occipito frontal circumference was greatest. The measurement was taken nearest to 0.5 cm.

Mid arm circumference

A flexible narrow tape was used to measure the arm length from acromion to olecranon at the midpoint of this length, mid arm circumference taken. MAC is measured in children to the nearest of 0.1 cm.

Statistical Analysis:

Descriptive statistics like frequencies and percentages were obtained. All results were tabulated and percentage was arrived by using windows MS Excel application and the analysis was performed by using

SPSS version – 15.0 software.

RESULTS

Samples were tabulated age wise, sex wise. Results were also tabulated according to various anthropometric measurements in both sexes. Total children enrolled -896

Length for age:

The percentile charts of length for age for boys and girls are presented in table 2 & 3.

The 50^{th} percentile and mean value of length for age in boys were marginally higher than for girls. This was also true for 3^{rd} and 97^{th} percentile.

At birth, for boys the 50^{th} percentile length is 48.8 cm and the 3^{rd} 15^{th} 85^{th} and 97^{th} percentile were 45.1, 46.5, 50.5 & 51.9 cm respectively. For girls in this age group the 50^{th} percentile length is 48.4 cm and the 3^{rd} 15^{th} 85^{th} and 97^{th} percentile were 44.6, 46, 49.2 & 50.8 cm respectively.

At 3 months, for boys the 50^{th} percentile length is 58.9 cm and the 3^{rd} 15^{th} 85^{th} and 97^{th} percentile were 55.2, 56.9, 61.8 & 63.8 cm respectively. For girls in this age group the 50^{th} percentile length is 57.6cm and the 3^{rd} 15^{th} 85^{th} and 97^{th} percentile were 53.9, 55.3, 61.2 & 62.6 cm respectively.

At 6 months, for boys the 50^{th} percentile length is 64.5 cm and the 3^{rd} 15^{th} 85^{th} and 97^{th} percentile were 60.5, 61.8, 67.8 & 68.4 cm respectively. For girls in this age group the 50^{th} percentile length is 63.4 cm and the 3^{rd} 15^{th} 85^{th} and 97^{th} percentile were 59.2, 60.6, 66.4 & 67.9 cm respectively.

At 9 months, for boys the 50th percentile length is 68.9 cm and the 3rd 15th 85th and 97th percentile were 64.6, 66.2, 71.4 & 73.2 cm respectively. For girls in this age group the 50th percentile length is 68.1 cm and the 3rd 15th 85th and 97th percentile were 63.2, 64.7, 70.5 & 72.2 cm respectively.

At 12 months, for boys the 50th percentile length is 73.2cm and the 3rd 15th 85th and 97th percentile were 68.2, 70.1, 75.8 & 77.5 cm respectively. For girls in this age group the 50th percentile length is 72.2 cm and the 3rd 15th 85th and 97th percentile were 67.9, 69.4, 75.2 & 76.9 cm respectively.

At 18 months, for boys the 50th percentile length is 78.9 cm and the 3rd 15th 85th and 97th percentile were 74.6, 75.9, 83.5 & 85.1 cm respectively. For girls in this age group the 50th percentile length is 77.8 cm and the 3rd 15th 85th and 97th percentile were 72.2, 73.7, 82.9 & 84.6 cm respectively.

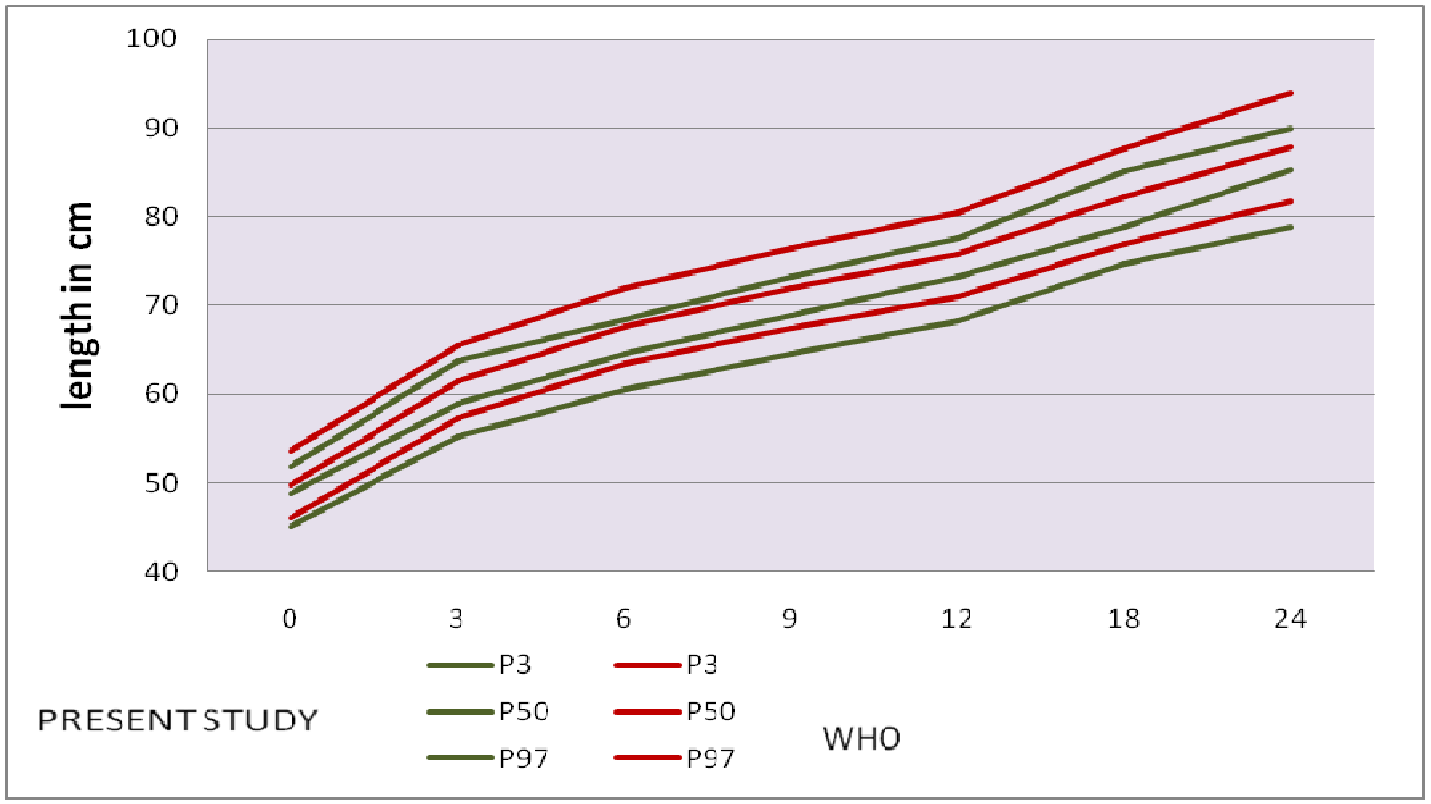
At 24 months, for boys the 50th percentile length is 85.2 cm and the 3rd 15th 85th and 97th percentile were 78.9, 81.2, 88.1 & 89.9 cm respectively. For girls in this age group the 50th percentile length is 84.2 cm and the 3rd 15th 85th and 97th percentile were 77.8, 79.3, 87.4 & 89.12 cm respectively.

TABLE 2:
Percentile for length (cm) of boys from birth to 2 yrs

	3	15	50	85	97
birth	45.1	46.5	48.8	50.5	51.9
3 mo	55.2	56.9	58.9	61.8	63.8
6 mo	60.5	61.8	64.5	67.8	68.4
9 mo	64.6	66.2	68.9	71.4	73.2
12 mo	68.2	70.1	73.2	75.8	77.5
18 mo	74.6	75.9	78.9	83.5	85.1
24 mo	78.9	81.2	85.2	88.1	89.9

FIGURE 1:

Comparison of length in cm for boys between WHO and present study



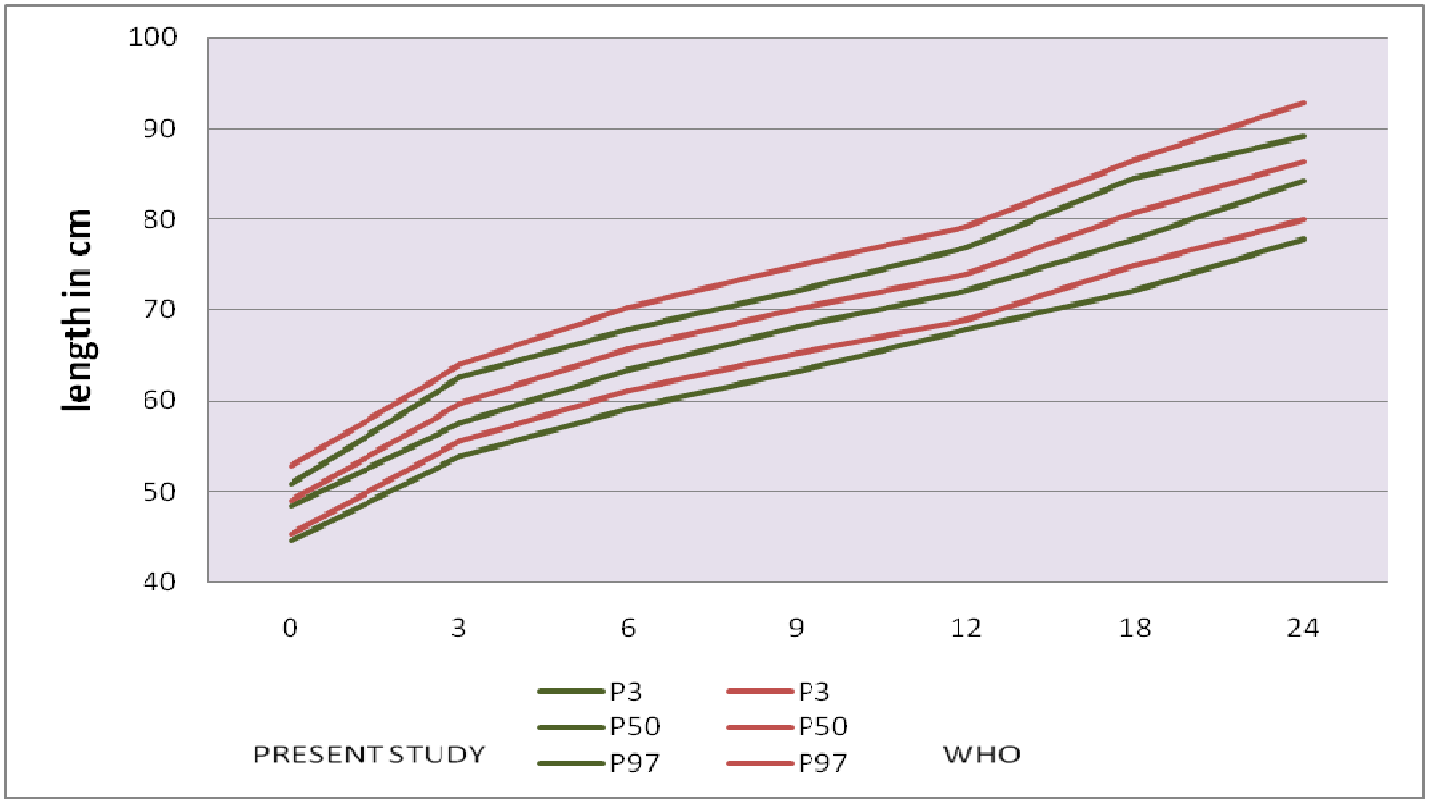
Age in months

TABLE 3:
Percentile for length (cm) of girls from birth to 2 yrs

	3	15	50	85	97
birth	44.6	46	48.4	49.2	50.8
3 mo	53.9	55.3	57.6	61.2	62.6
6 mo	59.2	60.6	63.4	66.4	67.9
9 mo	63.2	64.7	68.1	70.5	72.2
12 mo	67.9	69.4	72.2	75.2	76.9
18 mo	72.2	73.7	77.8	82.9	84.6
24 mo	77.8	79.3	84.2	87.4	89.12

FIGURE 2

Comparison of length in cm for girls between WHO and present study



Age in months

Weight for age:

The percentile charts of weight for age for boys and girls are presented in table 4 & 5.

The 50th percentile and mean value of weight for age in boys were marginally higher than for girls. This was also true for 3rd and 97th percentile.

At birth, for boys the 50th percentile weight is 2.9 kg and the 3rd 15th 85th and 97th percentile were 2.4, 2.6, 3.4 & 3.8 kg respectively. For girls in this age group the 50th percentile weight is 2.8 kg and the 3rd 15th 85th and 97th percentile were 2.3, 2.5, 3.2 & 3.4 kg respectively.

At 3 months, for boys the 50th percentile weight is 5.79 kg and the 3rd 15th 85th and 97th percentile were 4.8, 5.2, 6.9 & 7.6 kg respectively. For girls in this age group the 50th percentile weight is 5.6 kg and the 3rd 15th 85th and 97th percentile were 4.2, 4.6, 6.8 & 7.1 kg respectively

At 6 months, for boys the 50th percentile weight is 7.0 kg and the 3rd 15th 85th and 97th percentile were 5.4, 5.9, 8.1 & 8.7 kg respectively. For girls in this age group the 50th percentile weight is 6.8 kg and the 3rd 15th 85th and 97th percentile were 4.9, 5.3, 8 & 8.2 kg respectively

At 9 months, for boys the 50th percentile weight is 8.2 kg and the 3rd 15th 85th and 97th percentile were 6.5, 6.9, 9 & 9.9 kg respectively. For girls in this age group the 50th percentile weight is 7.9 kg and the 3rd 15th 85th and 97th percentile were 6, 6.5, 9.1 & 9.4 kg respectively.

At 12 months, for boys the 50th percentile weight is 9.14 kg and the 3rd 15th 85th and 97th percentile were 6.82, 7.4, 10 & 10.7 kg respectively. For girls in this age group the 50th percentile weight is 8.7 kg and the 3rd 15th 85th and 97th percentile were 6.72, 7.1, 9.8 & 10.2 kg respectively

At 18 months, for boys the 50th percentile weight is 9.8 kg and the 3rd 15th 85th and 97th percentile were 7.9, 8.3, 10.9 & 11.9 kg respectively. For girls in this age group the 50th percentile weight is 9.6 kg and the 3rd 15th 85th and 97th percentile were 7.8, 8.3, 11.0 & 11.4 kg respectively

At 24 months, for boys the 50th percentile weight is 11.6 kg and the 3rd 15th 85th and 97th percentile were 8.9, 9.4, 13, 13.8 kg respectively. For girls in this age group the 50th percentile weight is 10.6 kg and the 3rd 15th 85th and 97th percentile were 8.6, 9.1, 13 & 13.5 kg respectively

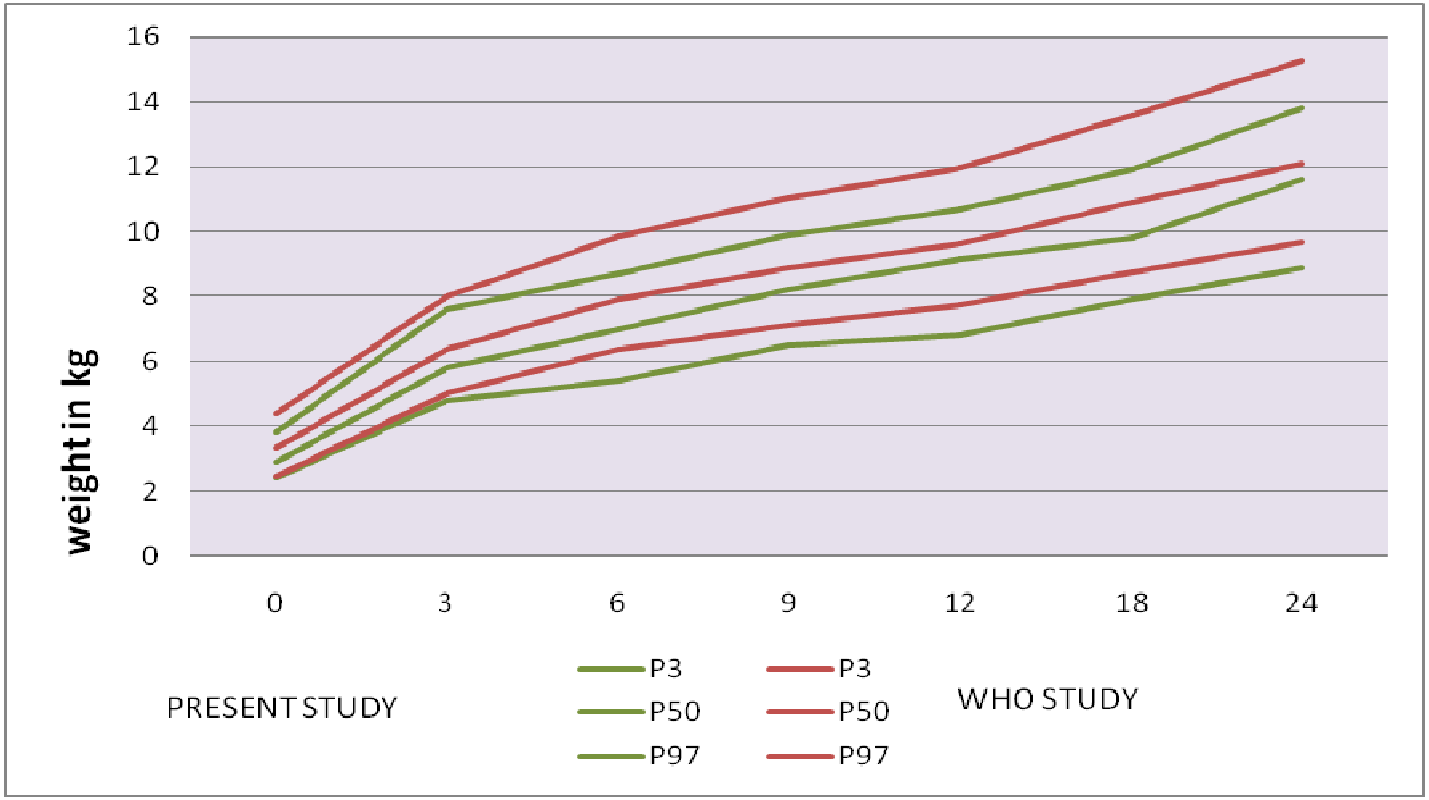
TABLE 4:

Percentile for weight(kg) of boys from birth to 2 yrs.

	3	15	50	85	97
birth	2.4	2.6	2.9	3.4	3.8
3 mo	4.8	5.2	5.79	6.9	7.6
6 mo	5.4	5.9	7	8.1	8.7
9 mo	6.5	6.9	8.2	9	9.9
12 mo	6.82	7.4	9.14	10	10.7
18 mo	7.9	8.3	9.8	10.9	11.9
24 mo	8.9	9.4	11.6	13	13.8

FIGURE 3:

Comparison of weight in kg for boys between WHO and present study



Age in months

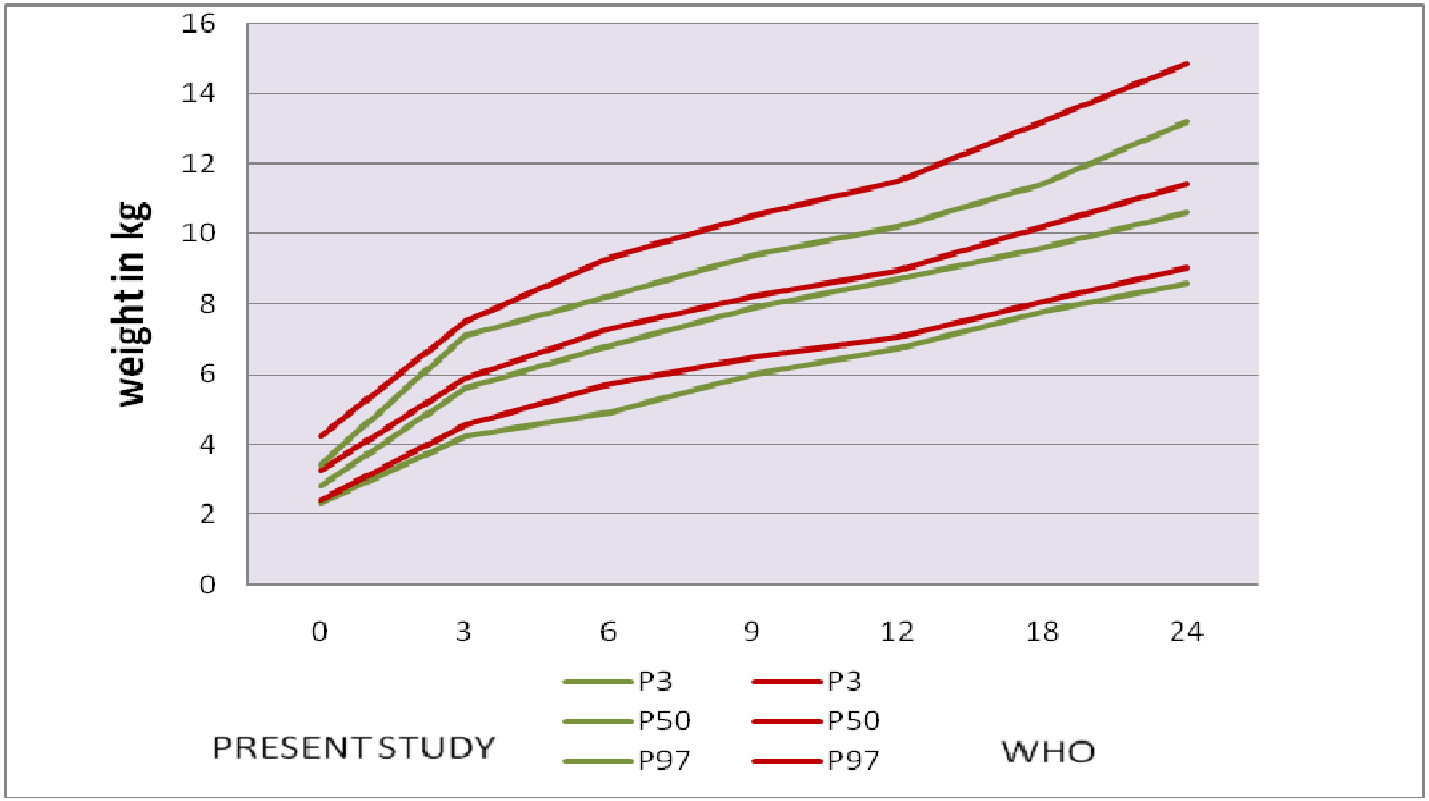
TABLE 5:

Percentile for weight (kg) of girls from birth to 2 yrs

	3	15	50	85	97
birth	2.3	2.5	2.8	3.2	3.4
3 mo	4.2	4.6	5.6	6.8	7.1
6 mo	4.9	5.3	6.8	8.0	8.2
9 mo	6	6.5	7.9	9.1	9.4
12 mo	6.72	7.1	8.7	9.8	10.2
18 mo	7.8	8.3	9.6	11.0	11.4
24 mo	8.6	9.1	10.6	13.0	13.5

FIGURE 4:

Comparison of weight in kg for girls between WHO and present study



Age in months

Head circumference:

The percentile charts of head circumference for age for boys and girls are presented in table 6 & 7.

The 50th percentile and mean value of head circumference for age in boys were marginally higher than for girls. This was also true for 3rd and 97th percentile.

At birth, for boys the 50th percentile head circumference is 34.2 cm and the 3rd 15th 85th and 97th percentile were 31.5, 32.2, 35.8 & 36.5 cm respectively. For girls in this age group the 50th percentile head circumference is 33.5 cm and the 3rd 15th 85th and 97th percentile were 31, 32.2, 34.9 &35.8 cm respectively.

At 3 months, for boys the 50th percentile head circumference is 39.4cm and the 3rd 15th 85th and 97th percentile were 37.4, 38.2, 40.8 & 41.6cm respectively. For girls in this age group the 50th percentile head circumference is 38.2 cm and the 3rd 15th 85th and 97th percentile were 36.8, 37.4, 40.2 & 41 cm respectively.

At 6 months, for boys the 50th percentile head circumference is 42.4 cm and the 3rd 15th 85th and 97th percentile were 40.4, 41.2, 43.2 & 44 cm respectively. For girls in this age group the 50th percentile head circumference is 41.5 cm and the 3rd 15th 85th and 97th percentile were 39, 40.2, 42.9 & 43.8 cm respectively.

At 9 months, for boys the 50th percentile head circumference is 43.5 cm and the 3rd 15th 85th and 97th percentile were 42, 42.8, 45.7 & 46.5 cm respectively. For girls in this age group the 50th percentile head circumference is 43.2 cm and the 3rd 15th 85th and 97th percentile were 41, 42.1, 44.2 & 45 cm respectively.

At 12 months, for boys the 50th percentile head circumference is 45.1 cm and the 3rd 15th 85th and 97th percentile were 43.2, 44, 47.3 & 48.1 cm respectively. For girls in this age group the 50th percentile head circumference is 44.4 cm and the 3rd 15th 85th and 97th percentile were 42.1, 42.7, 45.9 & 46.8 cm respectively.

At 18 months, for boys the 50th percentile head circumference is 46.7 cm and the 3rd 15th 85th and 97th percentile were 44.2, 45, 48.4 & 49.2 cm respectively. For girls in this age group the 50th percentile head circumference is 45.6 cm and the 3rd 15th 85th and 97th percentile were 43.1, 43.8, 47.2 & 48.1cm respectively.

At 24 months, for boys the 50th percentile head circumference is 47.9cm and the 3rd 15th 85th and 97th percentile were 45.3, 46.1, 49.4 & 50.2 cm respectively. For girls in this age group the 50th percentile head circumference is 46.8 cm and the 3rd 15th 85th and 97th percentile were 43.9, 44.8, 48.1 & 48.9cm respectively.

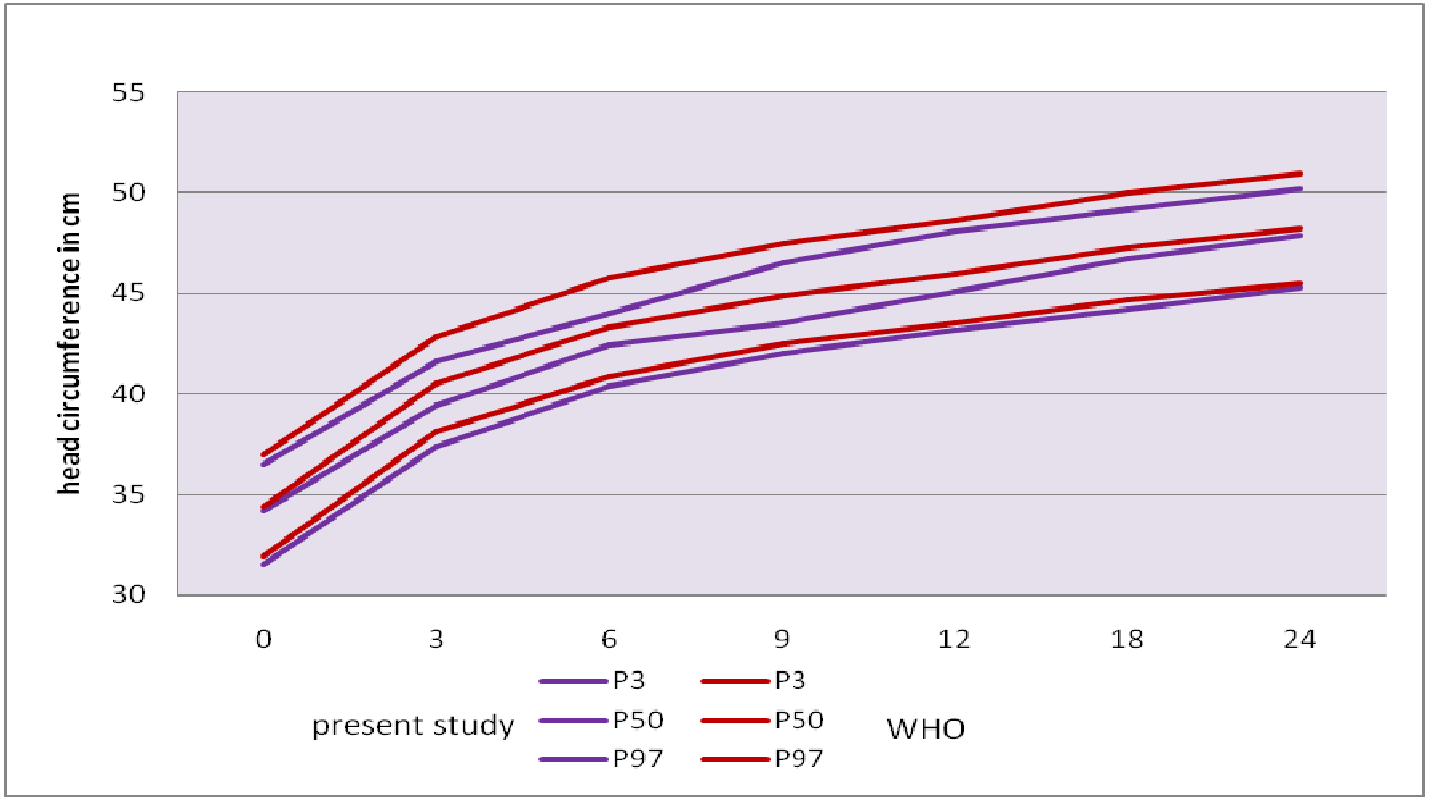
TABLE 6:

Percentile for head circumference (cm) of boys from birth to 2 yrs

	3	15	50	85	97
birth	31.5	32.2	34.2	35.8	36.5
3 mo	37.4	38.2	39.4	40.8	41.6
6 mo	40.4	41.2	42.4	43.2	44
9 mo	42	42.8	43.5	45.7	46.5
12 mo	43.2	44	45.1	47.3	48.1
18 mo	44.2	45	46.7	48.4	49.2
24 mo	45.3	46.1	47.9	49.4	50.2

FIGURE 5:

Comparison of head circumference in cm for boys between who and present study



Age in months

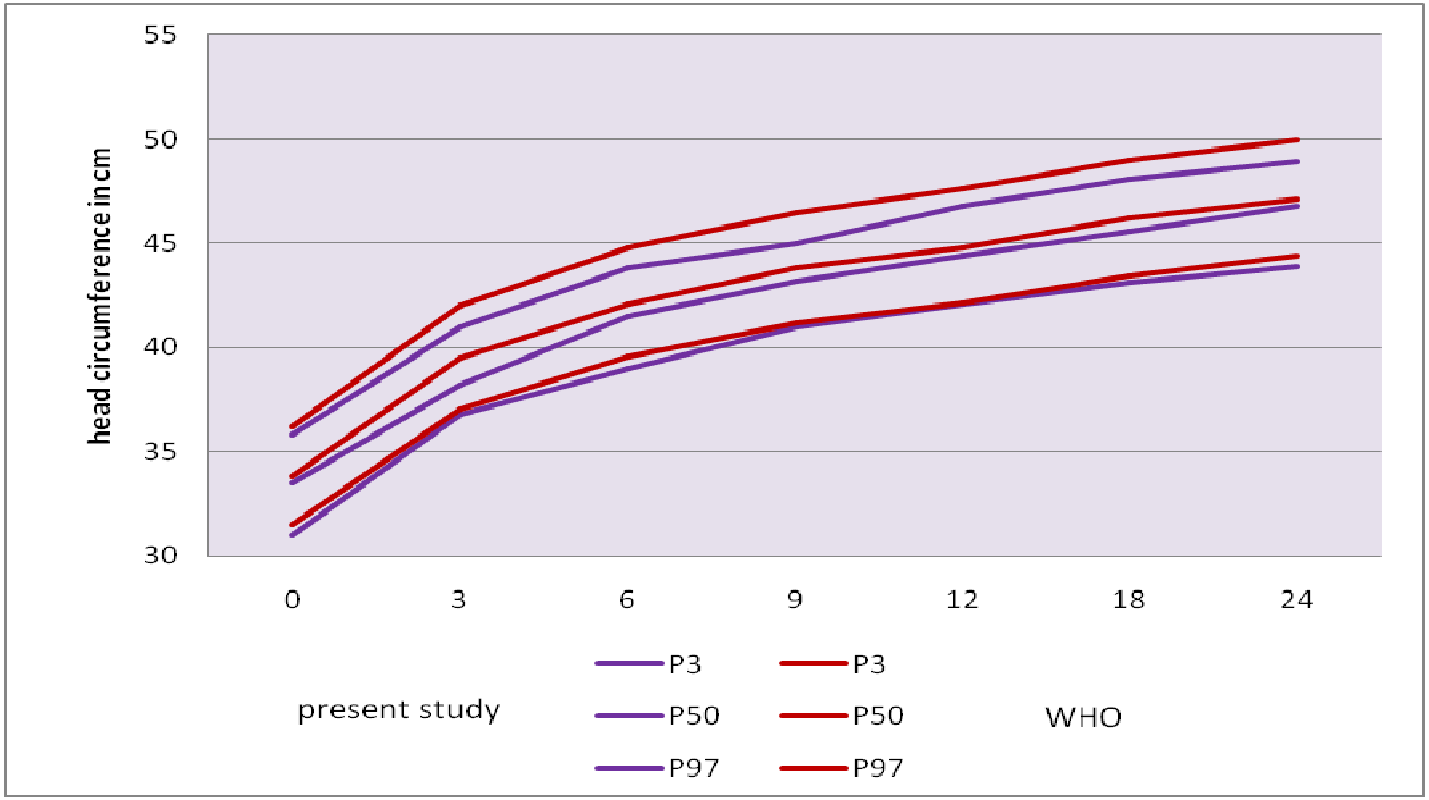
TABLE 7:

Percentile for head circumference (cm) of girls from birth to 2 yrs

	3	15	50	85	97
birth	31	32.2	33.5	34.9	35.8
3 mo	36.8	37.4	38.2	40.2	41
6 mo	39	40.2	41.5	42.9	43.8
9 mo	41	42.1	43.2	44.2	45
12 mo	42.1	42.7	44.4	45.9	46.8
18 mo	43.1	43.8	45.6	47.2	48.1
24 mo	43.9	44.8	46.8	48.1	48.9

FIGURE 6:

Comparison of head circumference in cm for girls between WHO and present study



Mid arm circumference:

The percentile charts of head circumference for age for boys and girls are presented in table 8 & 9.

The 50^{th} percentile and mean value of mid arm circumference for age in boys were marginally higher than for girls. This was also true for 3^{rd} and 97^{th} percentile.

The maximum increment in mid arm circumference appears to be till 9 months and thereafter only small increments seen.

TABLE 8:

Percentile for mid arm circumference (cm) of boys from birth to 2 yrs

	3	15	50	85	97
birth	7.2	7.6	8.4	9.4	10
3 mo	10.5	11.1	12.0	13.1	13.5
6 mo	12.1	12.6	13.6	14.6	15.1
9 mo	12.7	13.2	14.2	15.2	15.7
12 mo	13	13.5	14.5	15.4	16.0
18 mo	13.5	14.0	15.0	16.1	16.5
24 mo	13.7	14.3	15.2	16.2	16.7

TABLE 9:

Percentile for mid arm circumference (cm) of girls from birth to 2 yrs

	3	15	50	85	97
birth	7.0	7.7	8.0	8.8	9.5
3 mo	10.3	10.8	11.8	12.6	13.2
6 mo	11.8	12.3	13.2	14.2	14.8
9 mo	12.4	13	13.8	14.6	15.2
12 mo	12.8	13.2	14.3	15.2	15.8
18 mo	13.2	13.7	14.9	15.4	16
24 mo	13.5	14.1	15.2	15.9	16.4

Table: 10

Comparison of weight (kg) of WHO[24], NCHS, Agarwal and present study.

Study		Birth	3 mo	6 mo	9 mo	12 mo	18 mo	24 mo
WHO	Boys	3.34	6.37	7.93	8.90	9.64	10.90	12.10
	Girls	3.23	5.84	7.29	8.22	8.94	10.20	11.40
NCHS	Boys	3.53	6.39	8.16	9.48	10.46	11.80	12.74
	Girls	3.40	5.86	7.45	8.69	9.67	11.09	12.13
Agarwal et al	Boys	3.10	5.70	7.40	8.50	9.30	10.70	11.90
	Girls	3.20	5.40	7.00	8.10	9.00	10.40	*11.60*
Present study	Boys	2.9	5.79	7.0	8.2	9.14	9.8	11.6
	Girls	2.8	5.6	6.8	7.9	8.7	9.6	10.6

Table 10 shows the comparison of weight in kg for both girls and boys with that of WHO and other studies. It has been noted that the 50th percentile values of both sex were significantly lower than WHO standards but the values are comparable with Agarwal charts.

Table: 11

Comparison of height in cm of WHO[24], NCHS[20], Agarwal et al [19] and present study

Study		Birth	3 mo	6 mo	9 mo	12 mo	18 mo	24 mo
WHO	Boys	49.8	61.4	67.6	71.9	75.7	82.2	87.8
	Girls	49.1	59.8	65.7	70.1	74.0	80.7	86.4
NCHS	Boys	56.6	67.9	72.3	76.1	82.4	87.7	92.1
	Girls	55.3	66.1	70.6	74.4	80.8	86.2	91.1
Agarwal et al	Boys	50.4	59.4	65.9	70.6	74.3	80.7	86.0
	Girls	50.3	59.1	65.5	70.0	73.5	79.8	85.0
Present study	Boys	48.8	58.9	64.5	68.9	73.2	78.9	85.2
	Girls	48.4	57.6	63.4	68.1	72.2	77.8	84.2

Table 11 shows the comparison of length in cm of both boys and girls with WHO and other studies. It has been noted that the 50th percentile value of length in the present study is significantly lower than that of WHO charts.

Table:-12

Comparison of the head circumference of WHO, NCHS, and present study.

Study		Birth	3	6	9	12	18	24
WHO	Boys	34.4	40.5	43.3	44.9	46.0	47.3	48.2
	Girls	33.8	39.5	42.1	43.8	44.8	46.2	47.1
NCHS	Boys	35.8	41.8	44.0	45.5	46.5	47.9	48.7
	Girls	34.7	40.5	42.7	44.2	45.2	46.6	47.5
Present study	Boys	34.2	39.4	42.4	43.5	45.1	46.7	47.9
	Girls	33.5	38.2	41.5	43.2	44.4	45.6	46.8

Table 12 shows the comparison of head circumference in cm in both boys and girls with that of WHO and other charts. The 50^{th} percentile values were found to be lower than the 50^{th} percentile values of WHO charts.

Table:- 13

Comparison of mid arm circumference of Agarwal [19] and present study.

Study		Birth	3	6	9	12	18	24
Agarwal et al	Boys	9.8	12.3	13.7	14.3	14.5	15.1	15.0
	Girls	9.9	12.2	13.5	14.1	14.3	14.7	15.0
Present study	Boys	8.4	12.0	13.6	14.2	14.5	15.0	15.2
	Girls	8.0	11.8	13.2	13.8	14.3	14.9	15.2

Table 13 show the comparison of mid arm circumference of Agarwal and present study shows the values are comparable except at birth.

DISCUSSION

India is a signatory of the millennium development goals by 2020 and is marching towards achievement of this goal. Health planners and policy makers allocate funds towards health care based on maternal and neonatal mortality rates. In spite of generous allocation of funds, neonatal mortality rate and low birth weight in India are still at very high level. Hence to achieve MDG goals, health planning is imperative.

A recent survey reported that 154 of 178 governments (88 percent) have growth monitoring in place[28] In many of these countries, growth monitoring is the main, and most visible activity for reducing malnutrition or for reaching the Millennium Development Goals of halving hunger by the year 2015 [29].

The purpose of this study is to facilitate the health planners through classification of nutritional status and thus providing an objective basis for decision making in relation to care. The precise criteria that are used to interpret growth chart data and to define the levels of care required must be based on local needs, resources and service pattern.

In human beings, the pattern of physical growth in an individual or community are result of genetic characteristics and environmental influences, among which infectious diseases and dietary intake are of particular importance in the developing areas of the world. For this reason monitoring of growth by using growth charts based on data obtained from local population is important.

The standards used for purpose of comparison vary widely, as do the systems for classification of growth deviation, not only from country to country but among areas within same country. This proliferation of charts has given rise to confusion in health services as to which is the most desirable for local use as well as for regional and international comparison.

Studies conducted by various workers Habicht[6], et al and Goldsteiner and Tanner[7] had argued for local standards, which needs to be updated from time to time to account for changing socioeconomic level.

The use of western standards set unattainable goal and over estimate the degree of under nutrition among children. The same could be avoided by using local standards.

During our study, we found about only 15% of babies were exclusively breastfed till 6 months, 50% of the babies were predominantly breastfed and 35% of them were on artificial feeds. This is in contrast to WHO recommendations of exclusive breast feeding till 6 months and continuation of breast feeding along with complementary feeding till 2 yrs of life as biological norm.

The complementary feeds were started at the end of 3 months in 13.7% of babies, by the end of 4 months in 36.3%.Most common food used for weaning is cow's milk (50%), followed by formula feeds(30.5%) and home based (19.5%). Mode of feeding is through bottle (45.5%), spoon fed (42.1%) and palada (12.4%).

Regarding maternal education, 16.7% of mothers were graduates, 49.3% had completed high school, 26.1% had completed middle school, 5.3% had only primary schooling and 2.6% were illiterate.

The above observations show variation in the breast feeding pattern and dietary practices in the local population may influence the growth pattern in that population, hence there is a need for local growth charts.

In the present study, the 50th percentile for boys in all age groups is below 50thpercentile as compared to WHO standards. For girls the 50th weight percentile of present study in all age groups is below 50th percentile as compared to WHO standards.

In length for age, 50th percentile line for both boys and girls of this study falls below 50th percentile in all age groups as compared to WHO standards. Similarly, 97thpercentile of this study fall below the 97th percentile of WHO standards.

The 50th percentile of head circumference in both boys and girls in all age groups lies below 50thpercentile as compared to WHO charts but the difference is minimal.

The mid arm circumference is not significant till 1 yr of age but it was included for completion purpose. It has been noted that the 50th percentile value of mid arm circumference in both sex were similar except for a marginal difference and the results were shown in table 8 & 9.

The maximum increment of mid arm circumference noted till 9 months thereafter the increments were smaller and similar. Similar finding were observed by the study by Agarwal et al [19]

Thus it could be said that the growth level attainable in India should be assessed on data obtained on regional level to avoid overestimate of under nutrition. It also shows the need for continuous effort to collect data for growth parameters in a nationwide approach will ultimately provide an assessment of optimal growth potential.

CONCLUSION

1. 50^{th} percentile values for weight, length, head and mid arm circumference were comparatively lower than the WHO standard.

2. Since WHO standard is based on ideal condition of baby growth including breastfeeding as biological norm, this is not the case in developing countries.

3. Use of local standards on regional basis avoids overestimate of under nutrition

4. Continuous efforts to collect data for growth parameters in a nationwide approach should be made to provide assessment of optimal growth potential.

5. It has been noted during our study that only 15% of babies were exclusively breastfed till 6 months, 50% of babies were predominantly breastfed and 35% of babies were on artificial feeds.

6. About 36% of mothers started weaning by 4 months

7. The most common food used for weaning was cow's milk (50%), followed by formula feed (30.5%)

8. The most common mode used for weaning babies is bottle feeds (65.5%) followed by palada (25%)

9. Most of the mothers have completed higher secondary (49.3%) and 16.7% of mothers were graduates.

LIMITATIONS OF THE STUDY:

1. Longitudinal follow up of cohort of babies of adequate sample size from birth to 24 months would have been the ideal one.

2. The population had mixed feeding habits of both breastfed and cow's ilk.

3. As the study was done in an urban hospital setup catering a population from poor socioeconomic status, the results cannot be extrapolated to represent that of entire Tamil Nadu

Proforma

S No :

Name : Address:

Age : Sex:

Op no : D.O.B:

Interview date :

Birth weight in gm :

Term/preterm :

H/O major illness : Yes/ No

Breast feeding :

Is baby breast feeds now : Yes/No

Age in which the complementary feed started.

Type of food: Home based / formula based

Mode: Bottle/Palada/spoon

Maternal education :

Income :

Anthropometric measurements :

Weight (gm) :

Length (cm) :

Head circumference (cm) :

Mid arm circumference (cm) :

BIBLIOGRAPHY

1. Current Diagnosis & Treatment: Paediatrics, Child Development & Behaviour Nineteenth Edition 2009 Chapter 2.
2. International Institute of Population Sciences. *National Family Health Survey –1*. Mumbai: IIPS, ORC Macro; 1993.
3. International Institute of Population Sciences. *National Family Health Survey –2*. Mumbai: IIPS, ORC Macro; 1998.
4. National Family Health Survey –3 factsheet.
5. Gragnolati M, Bredenkamp C, Gupta MD, Lee YK, Shekhar M. ICDS and persisting under nutrition. *Econ Polit Wkly* 2006; 41: 1193-201.
6. Habicht JP, Mortorella R, Yarbrough C et al Height and Weight Standards for preschool children: How relevant are the ethnic differences in growth potential? Lancet1974. 1, 611 – 615.
7. Goldstein H, Tanner JM. Ecological considerations in the creation and use of child growth standards Lancet 1980; 1: 582 -585.
8. Tanner JM .Use and Abuse of Growth standards In Human Growth.vol 3,3rd edition. Eds Frank F, Tanner JM. New York, Planum, 1986, pg 95 – 109.
9. IAP textbook of paediatrics, 4th edition. Chapter 4, Growth and Development, pg 80-96.

10. Waterlow JR, Buzina R, Keller W, Tanner J et al, The presentation and use of height and weight data for comparing the nutritional status of groups of children under the age of five years. Bull WHO 1977; 55: 489.

11. Shrimpton R, Victoria CG, de Onis M, Lima RC, Blossner M, Clugston G. Worldwide timing of growth faltering: implications for nutrition interventions. Paediatrics 2001; 1: 107.

12. Nelson textbook of Paediatrics, 18th edition. Chapter14, Assessment of Growth. pg 70-74.

13. Tanner and Whitehouse Archives of disease of child 1966; 41: 613.

14. Gopalan BMJ malnutrition in childhood in tropics 1967; 4: 603.

15. Arun.K Srivatsav Nutritional state of rural preschool children around JabalpurB Indian Pediatr 1970; 7: 313.

16. Datta Banick ND Study of physical growth in children 0-5 years. Indian J Med. January 1970.

17. Chandra et al Health and nutritional status of preschool children in rural Tamil Nadu. Indian Pediatr 1978; 15: 499.

18. Vimlesh et al Growth standards for developing countries. J Tropical Paediatrics April-June 1979.

19. Agarwal DK, Agarwal KN. Physical growth in Indian affluent children (Birth - 6 years). Indian Pediatr 1994: 31: 377-413.

20. Official 2000 centres for disease control (CDC) growth charts and percentile charts by NCHS, www.cdc.gov/growth charts.

21. World Health Organisation, A growth chart for international use in maternal and child health care. Geneva, 1978.

22. WHO Working Group on Infant Growth. : An evaluation of infant growth: The use and interpretation of anthropometry in infants. Bull World Health Organ 1995; 73: 165.

23. de Onis M and WHO Multicentre Growth Reference Study Group. WHO Child Growth Standards based on length/height, weight and age. Acta Paediatr Supplement 2006; 450: 76.

24. WHO Multicentre Growth Reference Study Group. WHO Child Growth Standards based on length/height, weight and age. Acta Paediatr (Suppl.) 2006; 450:76-85

25. Shankar Prinja , Jarnail Singh Thakur a & Satpal Singh bhatia . Pilot testing of WHO Child Growth Standards in Chandigarh: implications for India's child health programmes. Bulletin of the World Health Organ 2009; 87: 116-122.

26. Ramachandran P. *Adoption of WHO Child Growth Standards (2006) – issues and implications*. NFI Bulletin 2007; 28:1-6.

27. de Onis M, Onyango AW, Borghi E, Garza C, Yang H. Comparison of WHO Child Growth Standards and National Centre for Health Statistics/ WHO international growth standards: implication for child health programmes. *Public Health Nutr* 2006; 9: 942-7

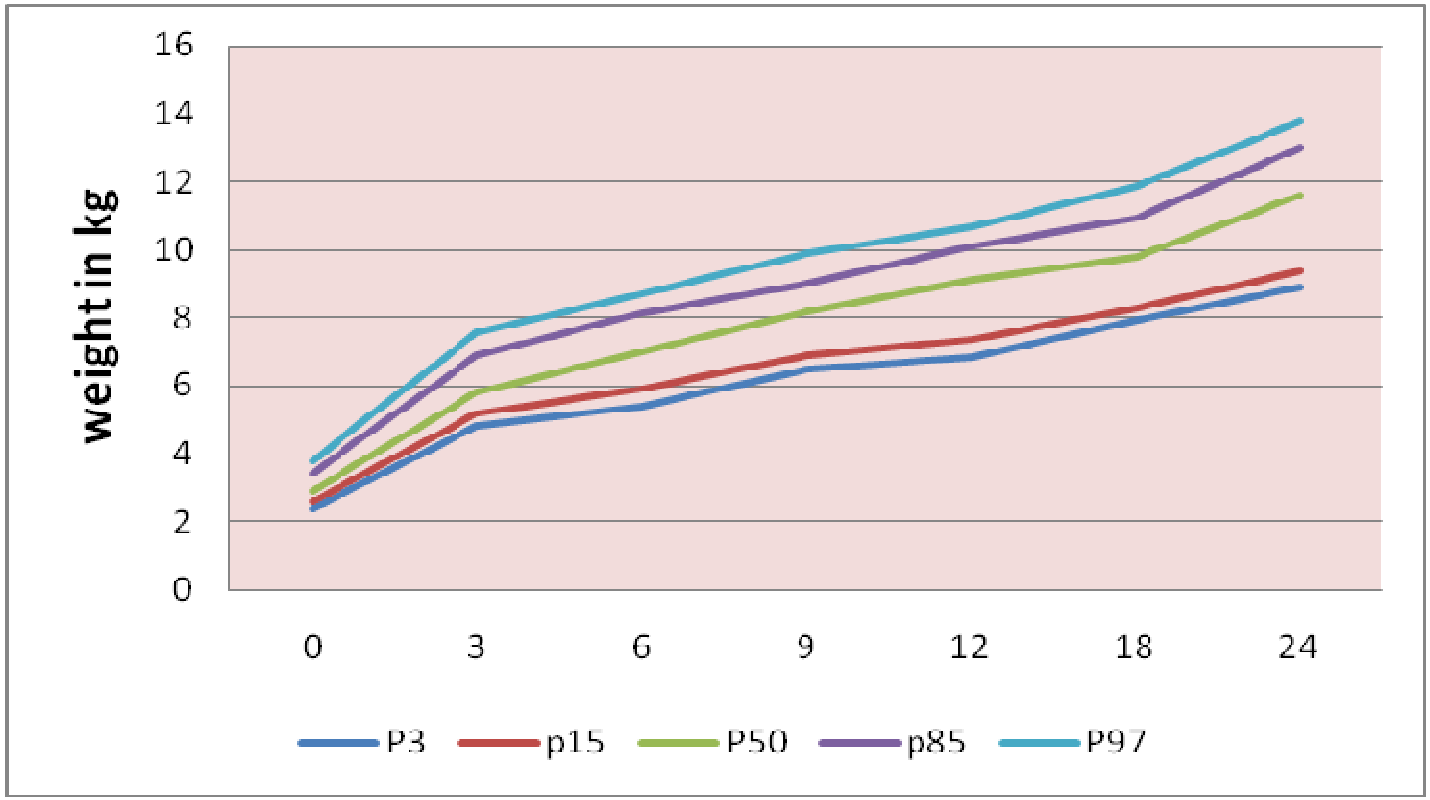
28. de Onis M, Wijnhoven TMA, Onyango AW. Worldwide practices in child growth monitoring. *Journal of Pediatrics* 144: 461-4, 2004.

29. Sachs JD. *The End of Poverty: Economic Possibilities for Our Time*. NY, Penguin Books. 2005

30. Bryce J, Coitinho D, Darnton- Hill I. Pinsturp-Anderson P for the Maternal and Child Under nutrition Study Group. Maternal and Child under nutrition: effective action at national level. *Lancet* 2008; 371: 510

ANNEXURE 1:

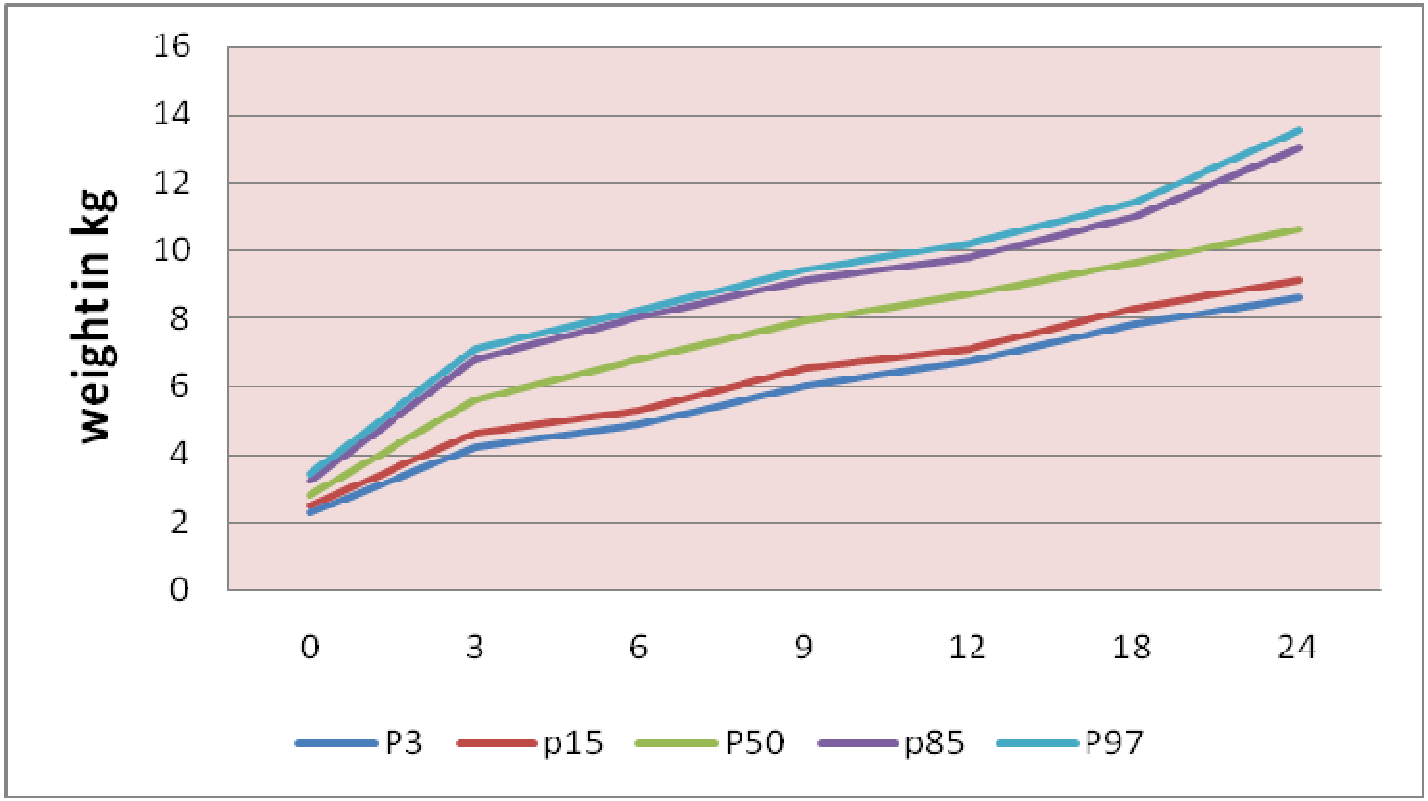
Weight for age percentile charts for boys birth to 2 yrs



Age in months

ANNEXURE 2:

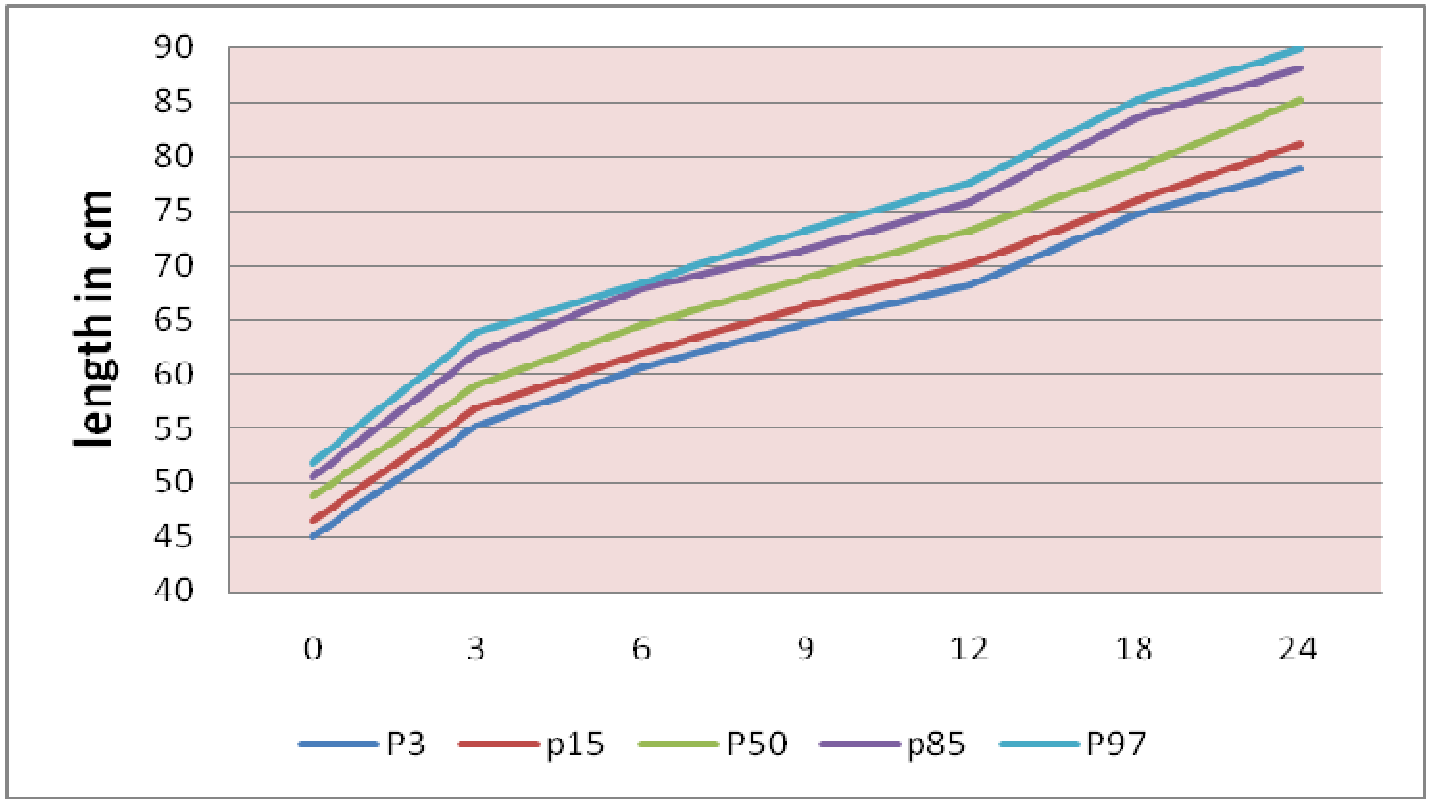
Weight for age percentile chart for girls birth to 2 yrs



Age in months

ANNEXURE 3:

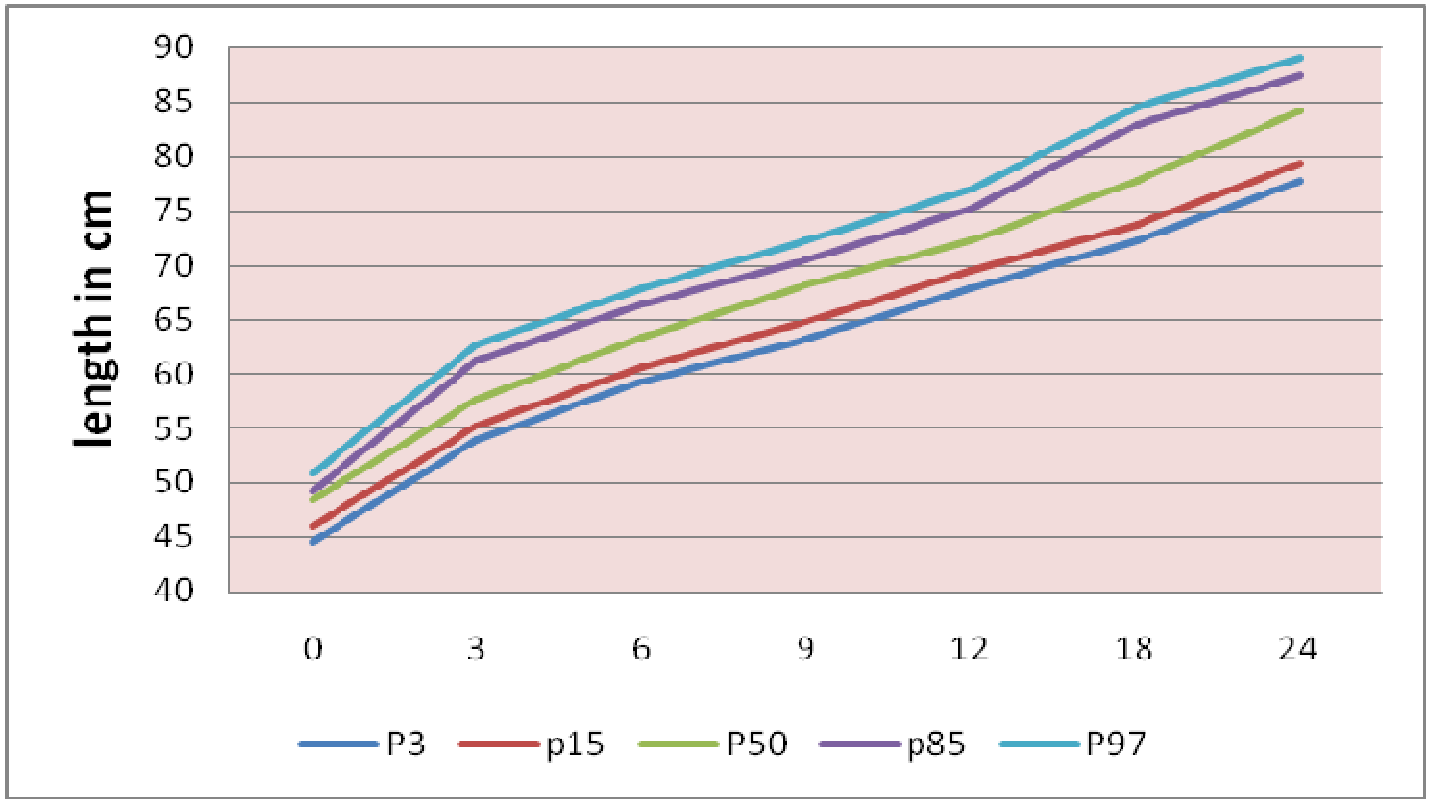
Length for age percentile chart for boys birth to 2 yrs



Age in months

ANNEXURE 4:

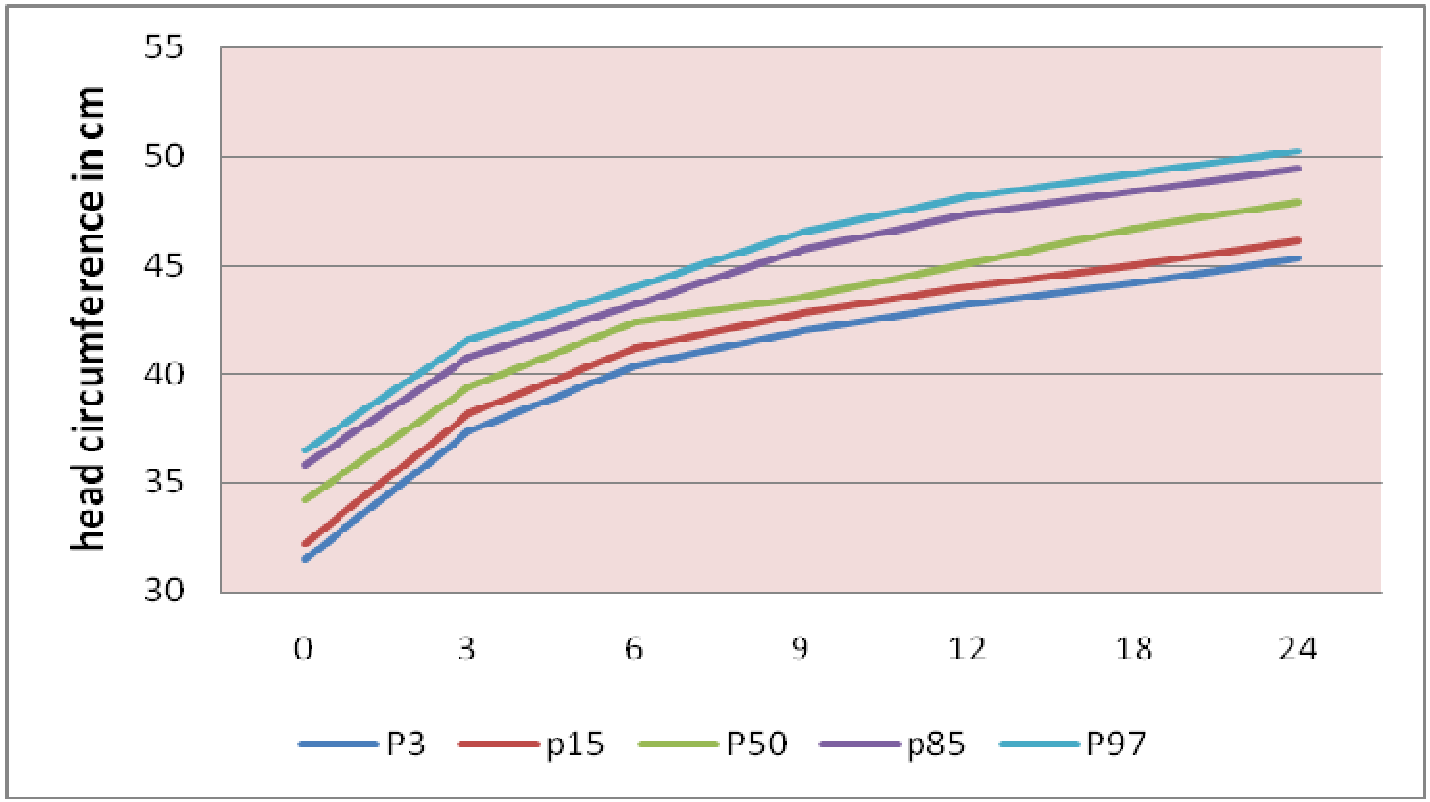
Length for age percentile chart for girls birth to 2 yrs



Age in months

ANNEXURE 5:

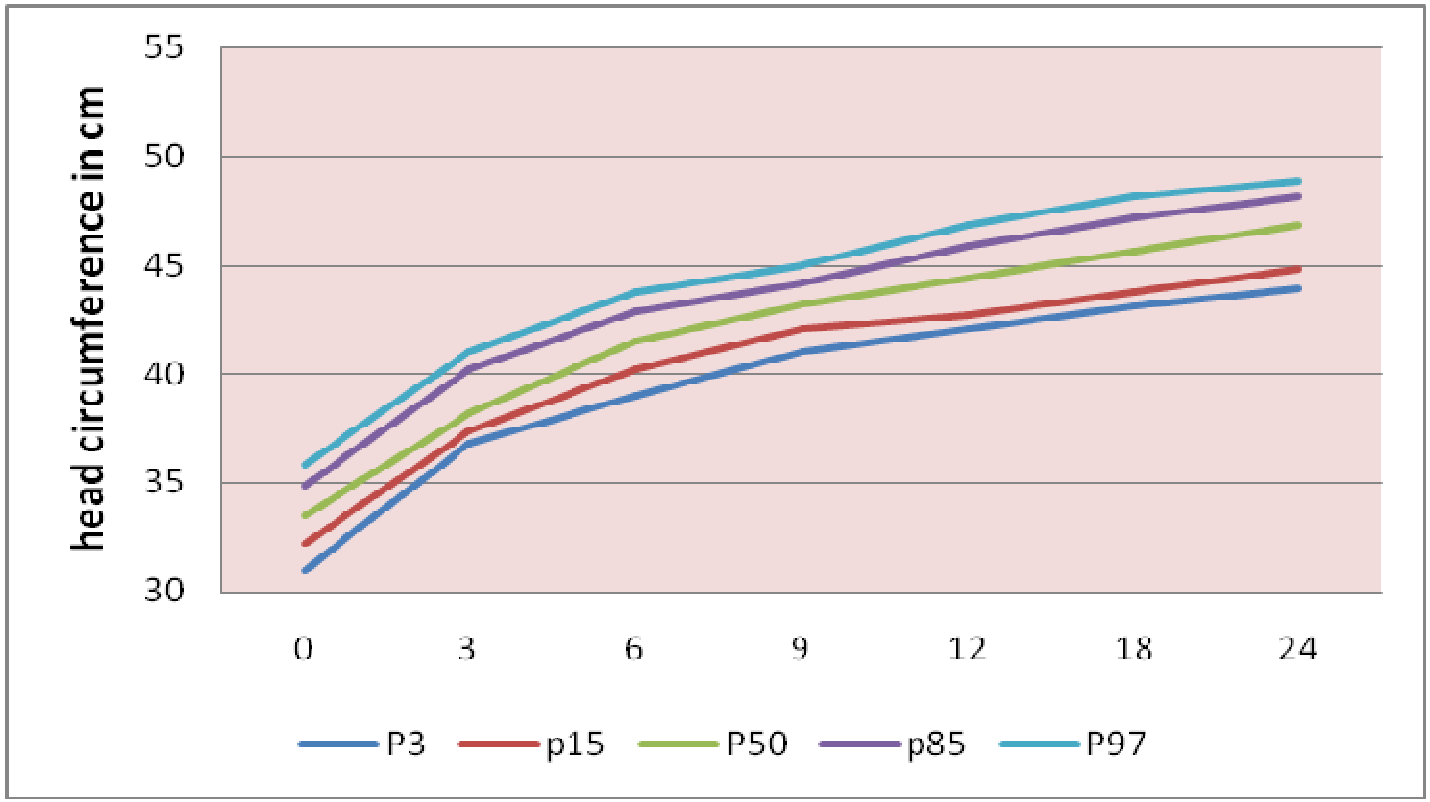
Head circumference for age percentile chart for boys birth to 2 yrs



Age in months

ANNEXURE 6:

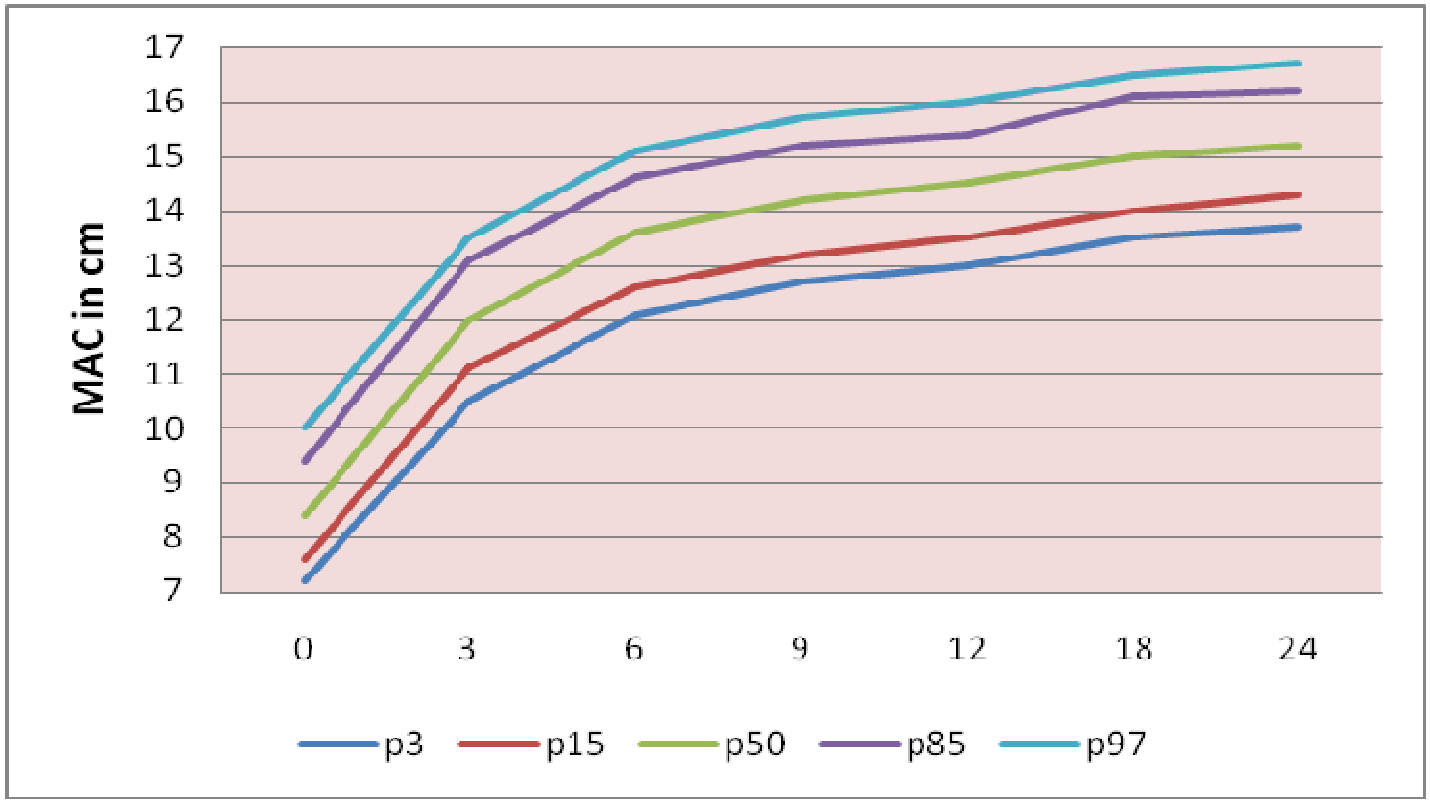
Head circumference for age percentile chart for girls birth to 2 yrs



Age in months

ANNEXURE 7:

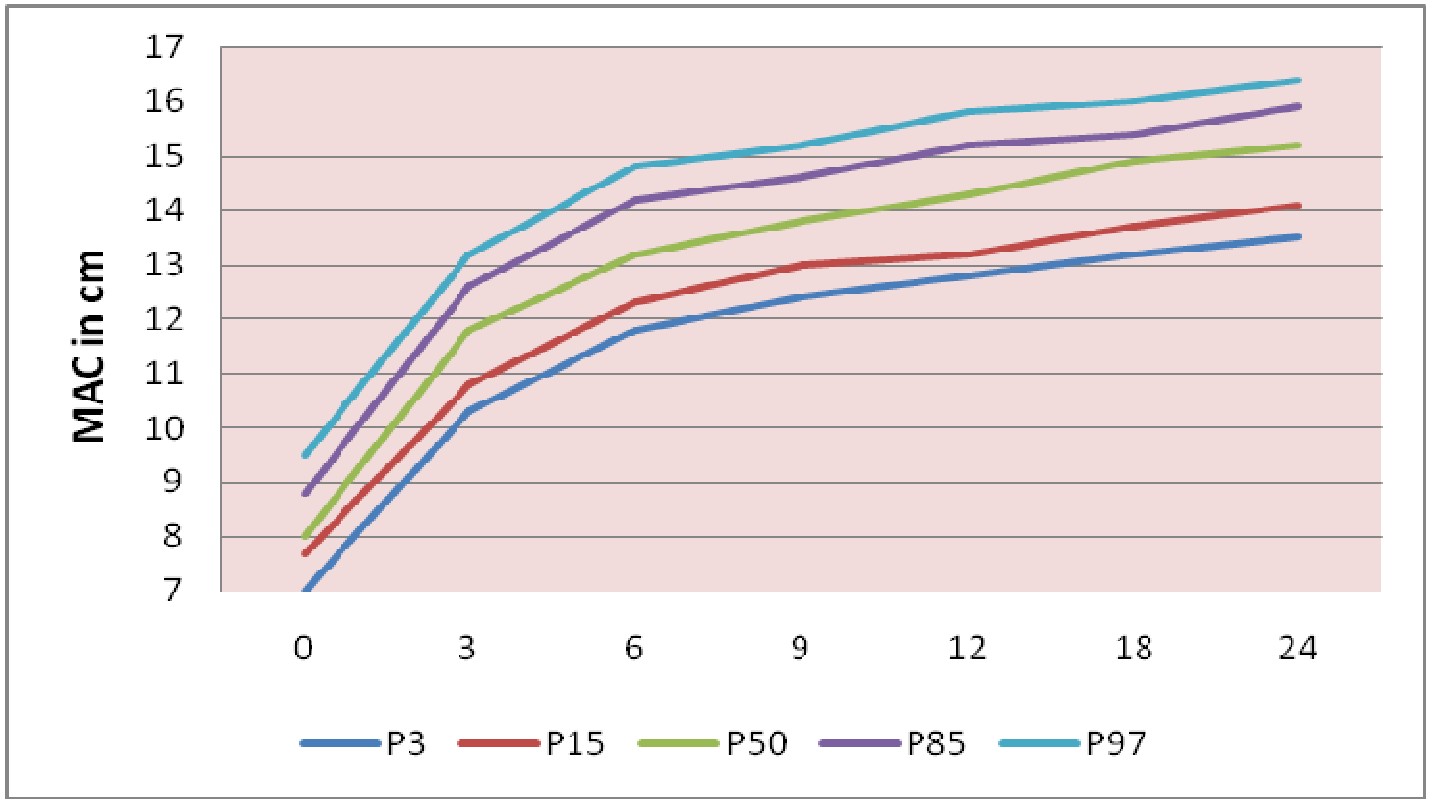
Mid arm circumference for age percentile chart for boys birth to 2 yrs



Age in months

ANNEXURE 8:

Mid arm circumference for age percentile chart for girls birth to 2 yrs



Age in months